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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Supervisor, Patent Prosecution Services
PIPER MARBURY RUDNICK & WOLFE LLP
1200 Nineteenth Street, N.W.
Washington, DC 20036-2412

EXAMINER	
HOGANS, DAVID L	
ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 01/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/975,256	RAMKUMAR ET AL.	
	Examiner	Art Unit	
	David L. Hogans	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 October 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This Office Action is in response to the Amendment filed on December 11, 2003.

Status of Claims

Claims 1-23 are pending.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 3 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The specification fails to teach wherein the oxide forming step is performed at a pressure of about 1.5 atm or less.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by 6,294,819 to Sun.

In reference to Claim 1, Sun teaches:

- forming an oxide layer (150) via thermal oxidation on a substrate (140) by oxidizing the substrate in a CVD furnace (i.e. - noting that the tantalum pentoxide layer is deposited in a CVD furnace) (See Figures 2a-2d and column 5 lines 01-50)
- introducing nitric oxide gas into the chemical vapor deposition furnace and nitriding the oxide layer in the presence of the nitric oxide gas (See Figures 2a-2d and column 5 lines 01-50)

5. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by 5,464,792 to Tseng et al.

In reference to Claim 1, Tseng et al. teaches:

- forming an oxide layer (14) via thermal oxidation on a substrate (12) by oxidizing the substrate in a CVD furnace (i.e. - noting that layer 14 can be a stacked CVD/thermal stacked gate oxide) (See Figure 1 and column 3 lines 03-29)
- introducing nitric oxide gas into the chemical vapor deposition furnace and nitriding the oxide layer in the presence of the nitric oxide gas (See Figure 1 and column 3 lines 03-29)

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 3-5, 7-10, 13-14 and 18-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al. in view of US 2002/0039844 to Lee in view of Silicon Processing for the VLSI Era (2000) to Wolf et al.

Claims 1 and 19

Oya et al. teaches forming an oxide layer (12 and/or 15) on a substrate (1) by oxidizing the substrate in a CVD furnace (See Figures 1-12 and column 6 lines 25-65 and column 11 lines 19-31); and introducing nitric oxide into the CVD furnace and nitriding the oxide layer at 800 °C and at a pressure less than 1 atm (See columns 6-7 lines 65-30, column 9 lines 25-35 and 60-65, column 10 lines 59-68 and column 11 lines 19-31).

Oya et al. fails to explicitly teach wherein the oxide layer on the substrate is grown through thermal oxide formation.

However, Lee, on page 3 paragraphs 0044 and 0053, teaches nitriding a thermally grown silicon dixode layer via nitric oxide.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating the nitridation of a thermally grown silicon dixode layer via nitric oxide, as taught by Lee, to produce a higher quality SiO_2/Si interface (see Wolf at page 198).

Furthermore, the specification contains no disclosure of either the critical nature of the claimed process (i.e. – oxide layer growth via thermal oxidation) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990)

The Examiner has not given patentable weight to the preamble limitation of "a gate oxide layer" because "[A] claim preamble has the import that the claim as a whole suggests for it". *Bell Communications Research, Inc. v. Vitalink Communications Corp.*, 55 F.3d 615, 620 (Fed. Cir. 1995) "If the claim preamble, when read in the context of the entire claim, recites limitations of the claim, or, if the claim preamble is 'necessary to give, life, meaning, and vitality' to the claim, then the claim preamble should be construed as if in the balance of the claim." *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305 (Fed. Cir. 1999). As the body of the claim makes no reference,

nor allusion, to a gate oxide layer (i.e. - the preamble does not recite limitations of the claim), and since the above referenced preamble limitation does not give life or meaning to the claim, it is deemed to be of no patentable weight. See MPEP § 2111.02

Claim 3

Incorporating all arguments of Claim 1 and noting that Oya et al., Lee and Wolf et al. fail to explicitly teach wherein the oxide forming step is performed at a pressure of 1.5 atm or less.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the oxide layer at a pressure of 1.5 atm or less, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955)

Furthermore, the Examiner notes that it is well known within the art that by reducing the pressure during thermal oxidation, one can better control the rate of oxide growth.

Claims 4 and 5

Incorporating all arguments of Claim 1 and noting that Oya et al. teaches performing the nitridation steps at a pressure less than 1.0 atm (See column 6 lines 54-61, column 10 lines 19-32 and column 10 lines 59-65)

Claims 7 and 20

Incorporating all arguments of Claims 1 and 19 and noting that Oya et al. teaches performing a second oxidation step after the nitriding step (See column 8 lines 46-65)

Claims 8-10 and 22

Incorporating all arguments of Claims 1 and 19 and noting that Oya et al. teaches depositing a polysilicon gate electrode layer (17) over the nitrided oxide layer with a tungsten silicide layer (See columns 7-8 lines 65-05)

Claims 13 and 14

Incorporating all arguments of Claim 1 and noting that Oya et al. and Lee teach a silicon substrate and a silicon oxide layer formed from an oxygen containing gas (See Oya et al. at column 6 lines 25-35 and column 11 lines 19-31 and Lee at page 3 paragraph 0053)

Claims 18 and 21

Incorporating all arguments of Claims 1 and 19 and noting that Oya et al. teaches depositing a gate electrode layer (13 or 17) on top of the oxidized nitrided gate oxide

layer (12 or 16) (See columns 6-8 lines 25-53 and column 11 lines 19-31 and Figures 1-12)

3. Claims 2 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al. in view of US 2002/0039844 to Lee in view of Silicon Processing for the VLSI Era (2000) to Wolf et al. in view of 6,294,819 to Sun.

Claims 2 and 6

Incorporating all arguments of Claim 1 and noting that Oya et al., Lee, and Wolf et al. fail to explicitly teach performing the oxidation and nitriding steps at approximately the same temperature and 800 °C or less.

However, Sun, in column 5 lines 01-07, teaches forming a thermally grown oxide layer, and nitridation of such layer, at 800 °C.

It would have been obvious to one of ordinary skill in the art to modify Oya et al., Lee, and Wolf et al. by incorporating a thermally grown oxide layer, and nitridation of such layer, at 800 °C, as taught by Sun, to form a gate oxide layer with a thickness between 10 and 60 angstroms.

1. Claims 11, 12 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al. in view of Applicant's own admitted prior art.

Incorporating all arguments of Claims 1, 8, 11, 19 and 22 and noting that Oya et al. fails to explicitly teach doping the gate electrode with a dopant or more specifically, boron.

However, Applicant's own admitted prior art, specification pages 1-2 lines 16-01, teaches boron doping of polysilicon gate electrodes of MOS devices. Further, the Applicant points out that polysilicon gate electrodes doped with boron exhibit reduced short-channel effects, lower threshold voltages and adequate conductance.

It would have been obvious to one of ordinary skill in the art to modify Ova et al. by incorporating boron doping of polysilicon gates, as admitted by Applicant as prior art, to reduce short-channel effects, lower threshold voltages and ensure adequate conductance of the gate electrode.

2. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al in view of 6,323,094 to Wu.

Incorporating all arguments of Claim 1 and noting that Oya et al. fails to explicitly teach an oxide layer having a thickness 15 angstroms or less.

However, Wu, in columns 3-4 lines 67-26, teaches a gate oxide of 10 angstroms. Further, Wu teaches one can employ an ultra thin gate oxide because nitrided gate oxide layers exhibit better properties, such as, improved gate reliability for suppressing boron penetration.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating a nitrided gate oxide thickness of 10 angstroms, as taught by Wu, to suppress boron penetration and to increase transistor speed by reducing dimensions.

3. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al. in view of 6,436,818 to Hu et al.

Incorporating all arguments of Claim 1 and noting that Oya et al. fails to disclose wherein the oxide layer contains at least 1.5 wt.% of nitrogen.

However, Hu et al., in columns 9-10 lines 35-15, teaches wherein nitric oxide doping of a thermally oxidized layer produces a film with 5.4% N atoms by volume.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating nitric oxide doping of a thermally oxidized layer that produces a film with 5.4% N atoms by volume, as taught by Hu et al., to produce a nitrided oxide layer amenable to silicidation.

4. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over 6,479,349 to Oya et al in view of Microchip Fabrication to Van Zant.

Incorporating all arguments of Claim 1 and noting that Oya et al. fails to teach wherein the oxide layer is a dry oxide layer.

However, Van Zant, on pages 172-173, teaches formation of an oxide layer by a dry oxide process. Furthermore, Van Zant teaches that dry oxidation is the preferred general oxidation method for production of all advanced devices.

It would have been obvious to one of ordinary skill in the art to modify Oya et al. by incorporating formation of an oxide layer by dry oxidation, as taught by Van Zant, because dry oxidation is the preferred general oxidation method.

Response to Arguments

5. Applicant's arguments filed December 11, 2003, have been fully considered but they are not persuasive.

The Applicant's Representative initially proffers the following argument: "The distinction between these two methods produce oxide layers with highly variant physical properties. Oxide layers that are thermally grown are denser, less porous and with

higher breakdown strength than oxide layers prepared by chemical vapor deposition. Also, in a method involving thermal oxide growth, the gated oxide layers are of better quality with highly controllable thickness. Therefore, a method involving an oxide layer made by chemical vapor deposition cannot anticipate a method involving an oxide layer grown through thermal oxide formation.". In response the Examiner notes that the arguments of counsel cannot take the place of evidence in the record. *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); *In re Geisler*, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997) See MPEP § 2145 and § 716.01(c) As there is no evidence of record to support these assertions, they are deemed without moment. Additionally, the Examiner notes that the record fails to provide criticality as to the limitation that the oxide layer be grown via thermal oxidation. The Examiner notes that the only reference to such limitation is "The use of sub atmospheric pressures during thermal oxide formation can lower the oxidation rate and thus provide better thickness control for thin (e.g., 8 to 15 angstrom thick) oxide layers.". See Applicant's specification at page 8 line 4. Even taken in context, this sentence, at best, describes the effect of pressure upon thermal oxidation. It does not suggest the basis for Applicant's invention (i.e. – that a thermally grown oxide exposed to nitric oxide (NO) gas displays superior properties as compared to a CVD grown oxide layer exposed to a nitric oxide (NO) gas), as the Applicant's Representative proffers. Finally, the Examiner notes the lack of evidence upon the record contrasting NO nitrided thermally grown oxide with NO nitrided CVD grown oxide, as this type of evidence would seem to logically support the Applicant's proffered invention.

Secondly, Applicant's representative argues: "In addition, Ova et al. teaches away from the claimed invention in that one of ordinary skill in the art, upon reviewing the teaching of Oya et al. would be motivated to adopt chemical vapor deposition for forming an oxide layer *as the reference only teaches oxide formation by chemical vapor deposition* within a chemical vapor deposition chamber, and one of ordinary skill would be motivated to use the chemical vapor deposition chamber means as suggested by the reference in the conventional manner of utilizing the means as taught. The reference discloses chemical vapor deposition chambers for their express purpose of forming oxide layers by chemical vapor deposition." (emphasis added). The Examiner notes the following sections, *inter alia*, which teach thermal oxidation: column 4 lines 64-67, column 5 lines 20-25, column 6 lines 25-30 and column 7 lines 55-60. Therefore, the reference does not only teach oxide formation by chemical vapor deposition, as Applicant's Representative would propose. Said another way, Oya et al. does teach thermal oxidation in a CVD furnace.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (703) 305-3361 or (571) 272-1691, after February 9, 2004. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on (703) 308-4940. The fax phone

number for the organization where this application or proceeding is assigned is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

dh

CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800